E2-35: Hydrogen generation for field Use

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A number of analytical instruments that are used for field analysis require high purity hydrogen (e.g., field gas chromatographs for the study of sutomobile emissions and in the oil/natural gas industry require hydrogen for the operation of FID detectors and/or as the carrier gas). Due to potential safety hazards and the difficulty of transporting bulky cylinders, rapid generation of high purity hydrogen under field conditions has attracted attention in recent times. One possible method to do so is reported.

Two approaches were evaluated for the catalytic hydrolytic decomposition of sodium borohydride to generate hydrogen gas, with cobalt(II) as the catalyst. One approach was the addition of 40% w/w $CoCl_2$ in water to pellets of $NaBH_4$, and the other was the addition of water to $NaBH_4$ pellets doped with $CoCl_2$ (composition: 90% $NaBH_4$, 7.5% $CoCl_2$, 2.5% unreported). Both kinds of pellets are commercially available, and in both approaches, the pellets were placed in a stainless steel container and the appropriate solution was added, Hydrogen gas is generated in accordance with the reaction:

$$4CoCl_2 + 8NaBH_4 + 18H_2O \longrightarrow 2Co_2B + 8NaCl + 6B(OH)_3 + 25H_2$$

The pressure of the hydrogen gas generated was noted. A sample of the gas was analysed by gas chromatography with FID and TCD detection to check the purity of the gas.

Although it was possible to generate hydrogen using both of the above approaches, the latter approach was found to be more efficient. It was possible to produce about 12.2 l of hydrogen (under standard conditions) using 20 pellets (weighing approx. 4.0 g) and 20 ml of water by this approach within a period of 5 min. The purity of the gas was found to be approximately 98.3%.

The experimental set-up described above, with a suitable filter attached to it, is capable of delivering high purity hydrogen under field conditions. The construction and the operation of the generator is simple, rapid, and cheap.